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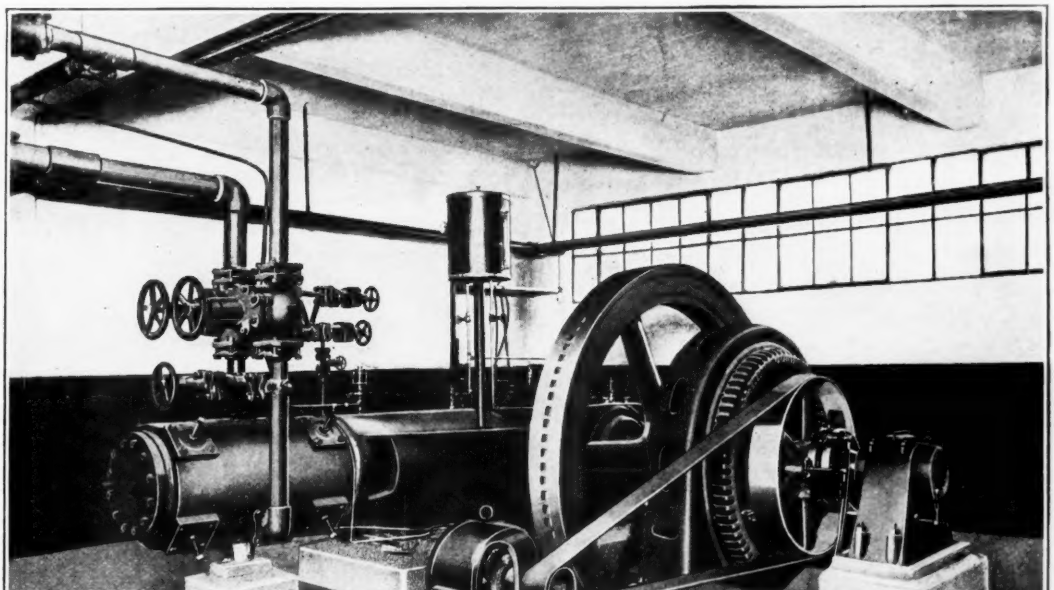


REFRIGERATING MACHINERY LUBRICATING

THIS is the season when manufacturers of ice and operators of cold storage plants are overhauling their machines and installing new equipment in anticipation of the demands of the hot weather which is approaching. Because of the plentiful supply of natural ice recently harvested in many parts of the country, makers of the artificial product will find competition very keen and

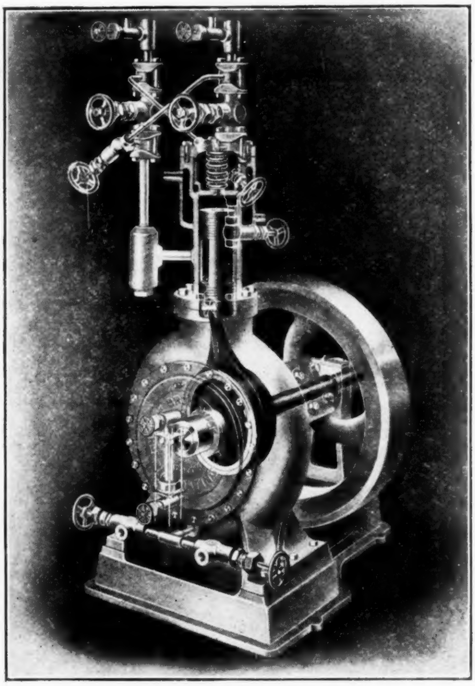
it is urgently necessary that they operate their plants at the highest possible state of efficiency. The surest way to obtain maximum production with minimum operating expense is to eliminate friction and leakage in the compressor cylinders and to provide against the fouling of the refrigerating coils with congealed oil. This article tells how all these difficulties may be obviated.

Although the commercial adoption of refrigerating and ice making machinery was begun only some forty years ago, the use of these appliances has already assumed very great proportions and it is safe to say that in few branches of mechanical engineering has a more remarkable development taken place. The process of refrigeration is now employed in many and diverse industries of which may be mentioned ice manufacturing plants, abattoirs and packing houses, cold storage warehouses, ice cream and candy factories, dairies, fur storages, hotels, hospitals and steel plants.

The sphere of application of refrigeration is widening year by year and new uses for the process are being found daily. The cooling of public and private buildings in hot climates has as yet scarcely been touched, and the production of ice and the preservation of foods have received practically no attention in many countries.

Refrigeration is defined as the cooling of a body by transferring its heat to another. The process of refrigeration has for its object the lowering of the temperature of a substance below that of its surroundings. We meet refrigeration every day in one or another of its forms. If air colder than our bodies blows upon us, we have a sense of coldness. The water from the sprinkling cart abstracts heat from the hot pavement and gives us a sense of relief by virtue of the fact that heat is absorbed when water is evaporated. Both of these are applications of the principles of refrigeration inasmuch as they produce reduced temperatures.

The lubrication of refrigerating machinery is a problem which in many instances has not received the attention from operators that the question deserves. This is evidenced by the wide variation in ideas regarding the question. The lubrication of refrigeration machinery is peculiar in that the choice of the oils to be used is influenced by the action of those oils upon parts of the apparatus not requiring lubrication. Before the characteristics of a successful compressor lubricant can be discussed a brief recital of the different methods of refrigeration would seem in order.



PHANTOM VIEW SMALL BRUNSWICK UNIT
SPLASH LUBRICATED

Two distinct methods of refrigeration are in use:

1—In which refrigeration is produced by expanding compressed air.

2—In which refrigeration is produced by evaporating a volatile liquid.

Air refrigerating systems may either use the air over and over again or allow it to escape after circulating it through the rooms to be cooled. The lubrication of apparatus employed in this method belongs under the head of air compressor lubrication and cannot be discussed here. The air system of refrigeration is used quite extensively on board ships because of the fact that no poisonous gases are entailed in its operation, and also because air in no way affects copper

and brass tubes which are necessary where salt water is encountered.

The second method of refrigeration may be conveniently divided into three processes:

(a) The vacuum process.
(b) The absorption process.
(c) The compression process.

In the vacuum process no attempt is made to recover the refrigerating agent, consequently water, because of its cheapness, is usually used. This process, which was invented in 1755, makes use of the phenomenon that water gives up its own heat to produce evaporation at reduced pressures, freezing being produced after about one-sixth of the original volume of water has been evaporated. The ice may then be removed or may be used as it stands to cool other objects. This process, as far as known, has never had successful commercial application, although it has been used to some extent for domestic purposes. Lubrication of the vacuum pumps employed in this process involves no difficult features, the chief requirement being that the oil should have sufficient viscosity to maintain a seal between the piston rings and the wall of the cylinder. For vacuum pumps in good condition, we recommend an oil of medium viscosity, while a somewhat heavier oil will be required to give economical results in cylinders which are slightly worn.

The absorption process is chemical rather than mechanical. It makes use of the fact that many vapors of low boiling point are readily absorbed by water and can be easily separated again when heat is applied. The absorption process has had a comparatively limited application. Large machines were built in France but they were not efficient because of the difficulty of obtaining an ammonia which was free from water. This difficulty was later overcome. Further improvements rendered the absorption process continuous and identical with the compression process with the exception that the return from low to high temperature is brought about by direct application of heat instead of by mechanical compression. In this process a strong ammonia solution is heated in a generator and the ammonia and water vapors driven off separated by cooling and other means. The almost anhydrous ammonia gas remaining is then further cooled and liquefied, after which it is fed through a regulating valve into the refrigerating coils where it evaporates. From the refrigerating coils the gas passes into a chamber where it is absorbed by a weak ammonia solution which, when sufficiently concentrated, is pumped back into the generator thus completing the cycle.

Lubrication of the pumps used in the absorption process presents no unusual features. If the exhaust from the pumps is condensed and used for ice making, care has to be exercised in selecting the cylinder oil in order that the ice shall not be discolored. This feature will be discussed in a subsequent article.

In the compression process the refrigerating agent is recovered by means of mechanical compression. It is said that this method of refrigeration was first commercially applied in 1861 at which time it was used in extracting paraffine wax from petroleum. This machine used ether as the refrigerating medium. Ether, sulphur dioxide, anhydrous ammonia, ethyl chloride and carbon dioxide have all been used to some extent, but now ammonia has been widely adopted. Carbon dioxide machines are still extensively used for refrigerating processes on board ships. Ethyl chloride machines are in use in the U. S. Navy.

Essentially the equipment for compression refrigeration consists of three parts, a compressor, a condenser, and an evaporator or refrigerator. There are important auxiliaries, of course, some of which will be discussed in later paragraphs, but it is with the compressor that this article is chiefly concerned.

In operation, the refrigerating agent in liquid form passes from the bottom of the condenser through a properly adjusted valve to the evaporating or refrigerating coils in a continuous stream. In the refrigerating coils the liquid encounters a pressure of from 10 to 25 pounds per square inch, depending upon the temperature required outside the coils. As a result, heat passes

from the substance outside the coil and is absorbed by the liquid which is then converted into vapor. Passing through the refrigerator the cold ammonia vapor is drawn into the compressor at a low temperature and compressed to a pressure of 125 to 185 pounds or over. Due to the work expended in compressing the vapor its temperature is raised but as most cylinders are water cooled the temperature rarely exceeds 250° F. From the compressor the hot vapor passes through an oil extractor to the condenser, in which it is again condensed to liquid thus completing the cycle. The discharge temperature is that at which ammonia gas will condense under existing discharge pressure.

Ammonia is compressed in one of two ways:

(a) By the wet method.
(b) By the dry method.

The object of the wet method is to prevent an undue rise in the compression temperature. To bring this about the regulating valve is set so that a little more liquid than can be evaporated is passed into the refrigerating coils. This liquid enters the compressor with the vapor and is evaporated there on the suction stroke by the heat of the compressor, its presence serving to keep the temperature of compression down.

Operators using the wet process are never certain that the excess liquid has completely evaporated at the end of the suction stroke. Unevaporated liquid constitutes a complete loss as it fills up the clearance space and in expanding occupies a considerable percentage of the compressor's capacity. To avoid this condition compressors designed for wet compression are often operated at higher discharge temperatures. These temperatures very seldom exceed 200° F., however. Theoretically, the wet method is more efficient than the dry, but in practice it is less efficient because of the quantity of ammonia which passes into the compressor in liquid form.

In selecting an oil for wet-compression machines it is necessary to choose one which will remain a fluid at the minimum temperature in the expansion side of the system, and of sufficiently high flash point to prevent distillation at the discharge temperature, but as the discharge temperature is comparatively low the cold or pour test and viscosity are the only important factors.

In the dry method, vapor alone is drawn into the machine, that is, the ammonia gas entering the compressor will be slightly superheated. The majority of machines operating in this class of work are vertical single-acting compressors with water jacket.

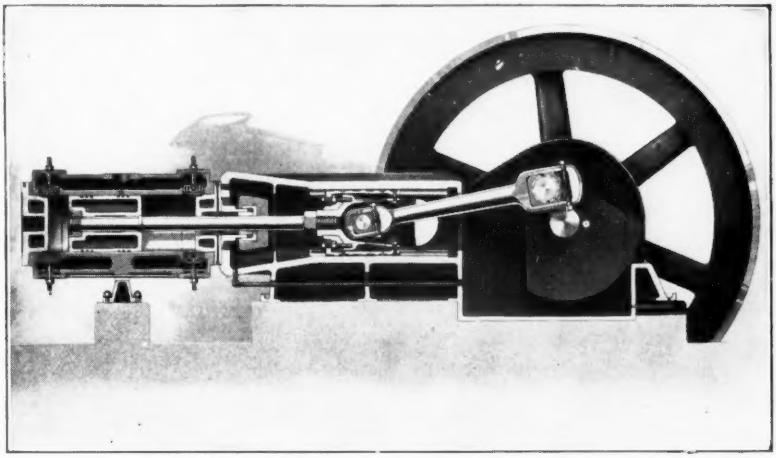
A great many horizontal spherical head double-acting compressors with and without water jackets are operated under these conditions. Discharge temperatures in the dry process will vary according to different conditions and methods of operation from 200° to 280° F., and under very extreme conditions may, at times, reach 320° F.

An oil for this class of work should have a sufficiently low pour test to remain a fluid at the minimum temperature in the evaporating side of the system, a flash point high enough to stand the discharge temperatures without distillation and enough viscosity to lubricate the compressor parts and seal the piston rings and compressor valves. As cylinder temperatures are considerably higher in dry compression than when the wet method is employed, it is desirable that an oil having a higher viscosity be used, and, in addition the oil should have a flash point sufficiently high to prevent distillation or cracking at the discharge temperature. A good ammonia oil should have a flash point at least 25° F. higher than the average discharge temperature.

We may divide the different types of ammonia compressors into four general classes:

(a) Vertical single-acting compressors.
(b) Horizontal double-acting compressors.
(c) Enclosed high-speed compressors.
(d) Rotary compressors.

Vertical single-acting compressors are built in various sizes from one-eighth ton capacity upward. The smaller types of these are usually lubricated by the splash system in a manner similar to that employed in automobile engines. When the back



SECTIONAL VIEW OF A DE LA VERGNE HORIZONTAL HIGH-SPEED COMPRESSOR

pressure drops below atmospheric in this type of machine there is always danger of oil being drawn into the cylinder, but this will never occur if the attendant watches his gauges closely and maintains the back pressure at the proper value. The ammonia piston used in a great many of these machines is of the double trunk type, with the charge entering between the upper and lower sections. The upper section is fitted with two or three rings and also contains a valve. The lower section carries one or two rings which form a seal between the crank case and the suction of the machine. These serve to prevent excess oil from being drawn into the cylinder when the back pressure drops. A light oil gives very satisfactory results upon this type of compressor.

Vertical machines are built with from one to four cylinders. In the larger sizes the lubrication of the working parts is accomplished through the use of a force feed circulating system. In machines using the splash system it is very important that the oil level in the crank case should not be kept too high. A high oil level causes excessive churning and is very liable to lead to the introduction of oil into the refrigerating system.

Some double-acting compressors are lubricated by introducing the oil at the piston rod stuffing box, which is fitted with an oil lantern. The small amount of oil working into the cylinder past the packing is found to afford ample lubrication. When this method is employed it is found that the oil protects the packing from the very injurious action of the hot ammonia gas. The De La Vergne compressor is lubricated in this manner. Other compressors are lubricated through the use of positive force feed lubricators, but where these are used precautions should be taken to see that they are constructed entirely of iron or steel. No copper or copper alloys should be used about an ammonia compressor. These lubricators assure efficient lubrication, in that they put the right amount of oil in the right place at the right time, and do this at the minimum cost. Oil is sometimes introduced into the cylinder through the intake line, but this method is now becoming obsolete.

The lubrication of the bearings of a compressor presents no unusual difficulties. When the splash method of lubrication is employed and one oil is used for both the cylinder and the bearings an ammonia oil of some type must be used, but when the oil is not used in the cylinder any high grade non-emulsifying oil may be employed. The same grade of oil may also be used when a circulating system is employed. When the oil is fed from cups or a force feed lubricator any high grade engine oil will prove satisfactory, the viscosity, of course, being suitable for the weight and speed of the machine in question.

The selection and proper application of a

suitable lubricating oil for the ammonia compressor is one of the duties of the lubricating engineer and a question of much importance to the engineer operating a refrigerating plant. In selecting an oil the character of friction, pressure, temperature and velocity and position of the moving parts, as well as the chemical nature and the composition of the lubricating oil must all be considered. Some attention must also be devoted to the chemical properties and temperature of the materials with which the oil may come in contact.

It should be noted that only pure mineral oils of at least zero pour test should be used in the cylinders of an ammonia compressor. These oils can be obtained with a sufficient range of physical properties to lubricate satisfactorily and efficiently all ammonia compressors working under reasonable conditions. Mineral oils are the most neutral, and a pure straight mineral oil well refined has been found to be the most suitable for this class of work. Compounded oils of any kind should be avoided because of the tendency of animal and vegetable oils to solidify at comparatively high temperatures. Acids which develop in compounded oils also attack the walls of the compressor cylinder and have a detrimental effect upon the ammonia gas.

Insofar as the lubrication of the compressors themselves is concerned, viscosity is of primary importance. The condition of the cylinder, piston rings and valves determines the viscosity of the oil that should be used, as it is essential that the oil should form a seal and maintain perfect compression. For cylinders which are in good condition a light bodied oil will prove satisfactory. Where the cylinders are somewhat worn or scored a medium bodied oil will usually maintain the required seal. In cases where the rings and cylinder are badly worn or scored it may be necessary to install a heavy bodied oil to insure efficient operation. Generally speaking, horizontal machines, due to the position and weight of the piston, require an oil of heavier viscosity than the vertical type, and as most of the horizontal compressors are double acting the lubrication of the piston rod should be taken into consideration.

As was mentioned before it is doubtful if the temperature of the oil in the compressor is ever raised much above 250°F. As all high quality oils have flash points well above 300°F., it would seem that the question of flash might safely be disregarded in selecting oils for compressor lubrication.

While oils having the characteristics just discussed will satisfactorily lubricate the compressor cylinder, requirements of other parts of the plant very frequently make necessary the use of an oil having other physical characteristics. There will always be some vaporization of oil due to the heat of compression no matter how high the flash point may be, and this vapor will be carried out of the cylinder with the compressed gas. As refrigerating systems are closed cycles this oil is bound to condense and accumulate upon the colder parts of the system which are the condenser and expansion coils.

Probably no one item in the operation of a refrigeration plant so vitally affects economy as the accumulation of oil upon the coils and yet it is amazing how few operating engineers take this problem seriously. A prominent authority has asserted that a film of oil one one-hundredth of an inch thick has the same heat resisting properties as a layer of boiler scale one-tenth of an inch thick and a steel plate ten inches thick. All oils when sufficiently cooled become thick and at certain temperatures cease to flow. Unless the oil reaching the condenser and refrigerating coil has an extremely low pour test it is bound to accumulate upon the walls of the coils and prevent the effective transfer of heat.

To prevent this condition an oil used in a refrigeration compressor should have at least a zero pour test, so that any oil getting into the coils may be carried along with the ammonia without congealing upon the walls and seriously affecting the efficiency and capacity of the plant. Natural low pour test oils contain no paraffine wax, and, consequently, no trouble from this source will be experienced when they are used. Before oils made from wax-bearing crudes are used on an

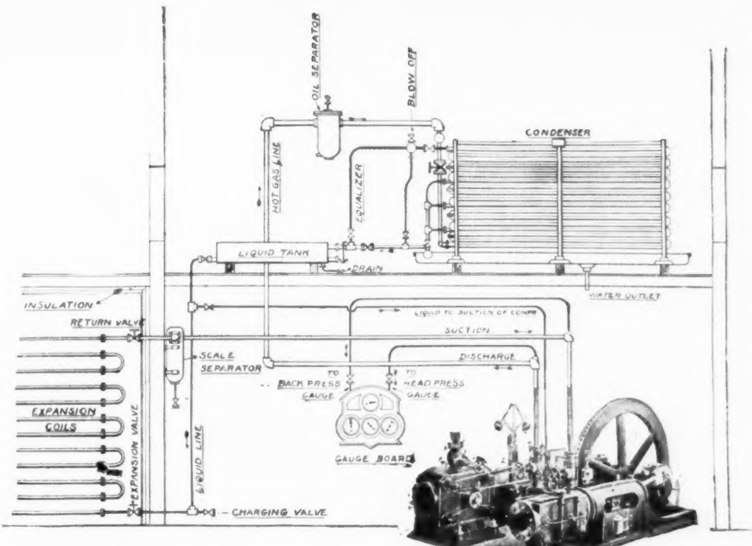


DIAGRAM OF DE LA VERGNE STANDARD REFRIGERATING PLANT

ammonia compressor it should be determined that the wax has been removed to such an extent that no evidence of its presence is seen after the oil has been exposed to the lowest temperature in the system. Any operator can make a test to determine the suitability of an oil for his particular work by immersing it in the brine for some time. If it flows readily upon removal it is quite suitable, if not, it should be rejected.

An essential appliance in any refrigeration plant is the oil extractor, of which there may be several. The principal extractor should be placed between the compressor and the condenser although advantages will be secured by inserting smaller extractors at the lowest points of the condensing and refrigerating coils. Efficiency will always be promoted by the use of oil extractors no matter how high the quality of the lubricant may be. Complaints are frequently made that the extractor does not function properly and very often extractor troubles are charged to the oil being used. In nine cases out of ten when the oil is not removed by the extractor the difficulty is due to the extractor being placed too close to the compressor, at which point the gases are too hot to permit the oil to condense. When the extractor is located close to the condenser the oil will reach it in a condensed form, and, as a result, can be more easily removed. Oil extractors should be of ample size so that the velocity of the gas through them shall not be too high to permit of complete separation.

The location of the oil extractor between the compressor and condenser and the efficiency of its operation have an important bearing upon the character of the oil selected. If conditions make it necessary to place the extractor near the compressor, an oil giving little evaporation, namely, a high viscosity oil should be used. On the other hand, due to the opportunity which the vapor has to condense, a lower viscosity oil may be used successfully when the extractor is placed some distance from the compressor. Provision should always be made to draw oil from the bottom of the liquid receiver in which it frequently accumulates in considerable quantities. As the oil has a higher specific gravity than liquid ammonia it naturally settles to the bottom of the receiver from whence it may be drawn and passed through purifying devices.

Oil taken from the extractors and receiver may be recovered by installing an ammonia distilling apparatus, which has the dual advantage of purifying the charge of ammonia and of recovering the lubricating oil without interfering with the continuous operation of the plant. The operation of these ammonia stills is so simple and well known to engineers in refrigerating work that it will not be necessary to go into details. Care should be taken in handling the distiller to prevent too rapid evaporation, as this causes boiling over and the loss of a large proportion of oil back to the suction line. After all the liquid ammonia has been evaporated and returned to the suction line of the compressors the oil can be drawn from the bottom of the still, using suction pressure for the purpose. The

oil removed will contain some water vapor and should be put aside until this has freed itself from the oil. Maintaining the oil at about 150°F. will assist this operation materially. The oil is then ready to be filtered.

It is advisable to use a separate filter for this work, the size and type of filter to be used depending upon the size of the plant and the amount of oil to be handled. The oil recovered from the still, after careful filtering, will again be suitable for the lubrication of the ammonia compressors provided the original oil used on the compressors is of good quality and properly selected.

Some engineers are opposed to filtering compressor oils through water because of the danger of moisture retained by the oil being introduced into the cylinder upon the re-use of the oil. On the other hand, a great many engineers have never experienced any difficulty through water getting into the system with oil. In any case this difficulty may easily be circumvented by allowing the oil to stand a day or so before again placing it in the lubricating system. In a large number of plants the oil recovered is used for external lubrication only and new oil used for the lubrication of the ammonia compressors. This is safe practice, as there is then positive assurance that the oil used on the ammonia compressors is perfectly clean and up to specifications.

A record should always be kept of the quantity of oil taken from the extractor, and this should be compared at regular intervals with the amount of oil fed to the compressor. Any great difference should be investigated at once. The film of lubricating oil can always be removed from the condenser coils by discontinuing the cooling water from one strand at a time. When the pipes become hot the oil will thin down and run off into the receiver. When the refrigerating coils become fouled with congealed oil the accumulation may be removed by reversing the system and forcing hot gas through the coils. The same result may also be obtained by blowing out the coils with steam followed by air to remove the moisture.

Temperatures play a very important part in the efficient operation of any refrigerating plant and to get the highest efficiency it is necessary to know what the temperatures are in the different parts of the system. This is also the most important consideration in selecting a lubricating oil for this class of work. Where thermometers are installed in both the suction and discharge sides of ammonia compressors the selection of a lubricating oil becomes a very simple matter.

The ideal refrigeration oil should remain a fluid at the minimum temperature in the evaporating side of the system and not undergo any chemical change at the maximum temperature of the compressor discharge. It should also have sufficient viscosity at the working temperature of the compressor parts to lubricate properly and to form a seal for the piston rings and valves.

The importance of a suitable and efficient lubricant for the ammonia compressor in many instances is overlooked and an oil "just as good" selling for a few cents per gallon less installed in the plant. When we consider that the average 100 ton modern ice plant will not use more than 50 or 60 gallons of ammonia oil per season, the difference in price between the best grade of oil procurable for this purpose and the cheapest oil sold, would not pay one per cent. on the difference in cost of repairs, to say nothing of the possibility of a loss in capacity due to the excessive wear of the compressor parts. Better lubrication will have a very large influence on operating costs. The seizing of one bearing or the loss of one discharge valve with the accompanying loss of service represents a great deal more than the difference between the costs of proper and improper lubrication.

SOLUBLE OILS IN USE

IN the last number of LUBRICATION we published an article on "Tool Lubricants and Coolants" in which it was pointed out that the use of a cutting lubricant is an absolute necessity wherever quantity production is attempted or high efficiency desired. In any modern plant it will be found that shortages of men and materials are met by the products of human ingenuity. Turret lathes, magnetic chucks, multiple-spindle drills, various automatic devices and high-speed tool steel have all had a share in speeding up production.

Recent years have witnessed great increases in the speed at which machining operations are carried on. The development of high-speed tools has introduced conditions which absolutely require the constant application of a cooling and lubricating medium to both the tool and the work, and today all up-to-date plants are equipped with systems for their circulation and purification.

It is realized by progressive manufacturers that the quality of a cutting compound has an important bearing upon the production of their plants. Today competition is so keen that only those plants operating at the peak of efficiency can long endure. If the life of the cutting tool can be prolonged there will be fewer delays due to changing tools and a consequent increase in production. In addition, a saving can be effected in expensive tool steel and through the reduction of the tool making force and equipment. Not only does a well lubricated and sharp tool require less power to operate it, but the power necessary is further reduced because of the higher speeds permissible.

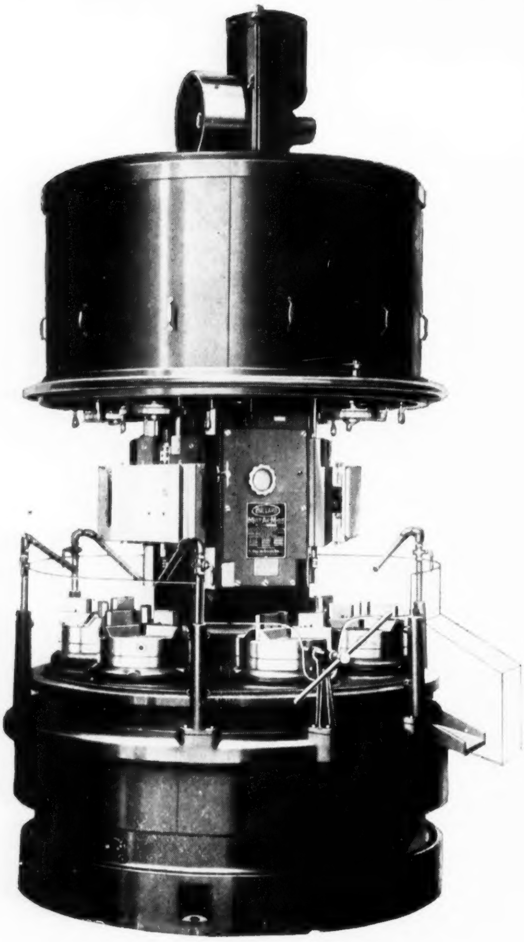
It is very interesting to note that as soon as the problem of improving cutting oils and the methods of using the same was attacked in a scientific manner, improvements were perfected which have led to a degree of efficiency never dreamed of before.

Of all the liquids available for the lubrication of cutting operations, soluble oil has the widest range of application. Water possesses the most pronounced heat absorbing qualities, but, unfortunately, the viscosity of water is so low that it does not form a satisfactory lubricating film between the chip and the lip of the tool. In addition, water soon corrodes the iron and steel upon which it plays. Mineral and fatty oils usually possess sufficient body to insure a satisfactory film on the lip of the cutting tool, and they are effective rust preventers, but their heat absorbing properties are only half as great as those of water.

Soluble oil, being a permanent emulsion of oil in water, possesses all the advantages of both water and the best tool lubricating oils, while all the undesirable qualities are eliminated. In addition, the consistency of soluble oils may be varied at will to conform to the requirements of the work in hand, the proportion of soluble oil in the emulsion being increased or decreased as a lubricating or cooling effect is desired.

It must not be forgotten that the successful use of a high-speed machine often depends more upon the conditions under which it is operated than upon the machine itself. Manufacturers of high-grade machinery appreciate that the life and performance of their products are largely dependent upon lubrication. The Bullard Mult-au-matic, manufactured by the Bullard Machine Tool Company, Bridgeport, Conn., is a notable example of the careful attention which is being given to this factor of machine design. The Mult-au-matic has been on the market several years but as its application is most successful in those plants where large quantities of the same piece are produced it is possible that many readers of LUBRICATION have not had an opportunity to study the characteristics of this machine.

During nearly forty years of manufacturing the Bullard Company has maintained that the question of lubrication is of paramount importance and one which must be kept in mind during all stages of design and manufacture. The wisdom of giving careful attention to lubrication in design is justified



BULLARD MULT-AU-MATIC

by the high esteem in which Bullard products are held by the great number of shops all over the world, and in every line of manufacturing in which machine tools have been installed. With the experience gained in making over ten thousand machines, it only follows that lubrication in this company's newest product, the Mult-au-matic, is as near perfect as possible, and the arrangements for lubricating the cutting tools show the same careful planning that has characterized the design of other parts of the machine.

The Mult-au-matic essentially consists of six engine lathes working in sequence on one base, and operated by one man whose only duties consist of loading and unloading. There are five working stations, each of which impresses the onlooker as being an engine lathe standing on its head and working better because of the new position, for all the humanly operated lathe motions are followed out without the mind or hand of man to guide them, and with slight possibility of human lapses in time and accuracy. The six independent work-holding spindles are mounted on a carrier or turret which revolves around a central column having six faces, the first of which, being the loading station, is blank. On the remaining five stations are mounted tool-carrying slides which are independently adjustable in rate of feed, length of cut and direction of motion. The time element of all automatic motion is therefore constant and cannot be varied or adjusted by the operator. A completely finished piece is produced in the time required for the longest operation of the sequence, plus the few seconds needed for the indexing of the carrier and its spindles from one station to the next.

The accompanying photograph shows one of the Mult-au-matics which produced with one operator, a finished cast iron friction gear blank requiring five separate machining operations, these operations including boring, reaming, angular and straight work and rough and finishing cuts in forty-seven seconds.

No harder test of the ability of a soluble oil to work satisfactorily could be had than was experienced on the Mult-au-matic during this job. The gear blanks were completely machined at the rate of one every forty-seven seconds and yet no undue heating of either the tool or work was observed. The building was very hot, but the oil did not show the slightest tendency toward breaking down or gumming. Cast iron is conceded to be very detrimental to soluble oils, causing them to discolor and to give off a bad odor, yet after ten days of continuous hard usage this soluble oil still held its pure white color and smelled as fresh as the day it was mixed.

In the article referred to above it was pointed out that the ideal soluble oil must:—

(a) Cool the tool and the metal being worked.

(b) Lubricate the lip of the cutting tool.

(c) Produce a good finish and protect the metal from corrosion.

(d) Permit higher working speeds and increased production.

(e) Show no tendency to gum, discolor, become rancid or give off offensive odors.

(f) Form a permanent emulsion which does not hold particles of metal in suspension and which shall be readily miscible with all kinds of water without prolonged agitation.

(g) Be reasonable as to price.

The Mult-au-matic was on exhibition at the Machinery Show held last June on Young's Pier, Atlantic City, N. J., in connection with the convention of the American Railroad Association and its remarkable features attracted the attention of many of the mechanical men attending the convention. The shop superintendents and master mechanics who gathered about the machine at the exhibition booth were enthusiastic over the lubrication of the mechanism, the character of the work and the perfect performance of the cutting medium used.

It will be of interest to our readers to know that Texaco Soluble Oil was used on this Mult-au-matic.

THE TREND OF OIL PRICES

Reprinted from National Petroleum News, February 11, 1920

Is the American oil industry face to face with an era of low prices? Will the depreciation of foreign exchange close the markets of the world to American oil and throw back on the domestic market a volume of petroleum products which the market will be unable to absorb and which will consequently break the price?

This question is raised by the more or less general feeling prevailing over the country that prices of staple commodities have reached their peak and that commodity prices are beginning or are about to begin a downward course due to the inability of citizens of foreign countries to buy American made goods at the present low foreign exchange rate. This feeling has received the affirmation of certain officials of the Federal Reserve Board and of some outside bankers.

Whether the Federal Reserve Board officials have sized up the situation correctly as to commodities in general remains to be seen. It is not believed, however, that the decrease will affect the oil industry. It is believed that the demand for all kinds of petroleum products will constantly increase, bringing a consequent stiffening of prices. This belief is based on the following facts:

1—The oil industry has not been experiencing the boom type of prosperity that other industries have enjoyed. There has been no inflation of prices, no so-called profiteering. The oil industry has gone along steadily and normally, sticking to the job and striving to make a decent profit against the handicaps of steadily mounting costs of supplies, labor and everything else entering into the conduct of business. The industry submitted in good faith to the price suggestions of the Petroleum War Service Committee during the war, and since those restrictions were removed has refrained from any attempt to charge "all the traffic will bear." In this the oil industry stands almost alone.

2—Oil is one of the essential commodities that European countries must have, regardless of price, if they are to rehabilitate their industries and get back on a normal production basis after the ravages and unsettled conditions of war. A low rate of exchange may check oil exports to some extent, but it is not going to reduce them to the point the market in this country will be surfeited.

Coal production all over Europe is at low ebb. In England, formerly the source of supply of much of the coal used in many European countries, the miners are working on a six-hour day basis or something like it

and are producing hardly enough coal to keep British wheels turning, let alone to supply British export trade. A large part of the French coal mines are out of commission for years to come if not permanently. France and Italy are practically dependent on oil for their industrial fuel.

3—Most of the oil being exported is sold on a basis of credit arranged by the oil companies themselves and their customers, independent of any government guarantee or arrangement. Most of the exporting companies have strong branch houses in Europe thru which the purchases are handled. In case of the Germans, most of the oil going to them from this country is being shipped sight draft against bill of lading, the financing being handled by a group of New York banks.

4—The growing demand for oil in this country, due to the enormous growth in the use of motor trucks, passenger cars and tractors, is expanding the demand for oil so rapidly that it is likely that the domestic market, within a few months, could absorb easily the entire output of American fields and refineries. According to expert calculation, there were in use in the United States in 1918 6,000,000 motor vehicles, while one great motor company alone was last October producing machines at the rate of 600,000 a year. The same calculator figured that the increase in motor vehicles put in service is at the rate of more than 1,000,000 a year. At the conservative estimate of two gallons of gasoline a day per machine that showed the daily gasoline consumption of 6,000,000 machines was 12,000,000 gallons a day, or 4,380,000,000 gallons a year. This demand, according to the figures, is increasing at the rate of 730,000,000 gallons a year. Our exports of gasoline have never exceeded about 500,000,000 gallons a year, a relatively small proportion of the total output of refineries here.

5—The increasing cost of everything entering into the bringing of oil from the ground makes it imperative that the producer get a high price for his crude to enable him to continue in business. One of the most trying problems faced by the producer is that of getting sufficient tubular goods and drilling tools, engines, etc., to carry on his operations. It is apparent to the student of market conditions that there is little possibility that the prices of these products will come down for a long time to come. The export situation has no effect on the steel mills insofar as the output of oil field goods is concerned. All the mills and supply houses are sold up from three months to a year or more ahead with little prospect of catching up as the demand for their products continues to increase. The scarcity of oil field supplies is due to the suspension of operations for many weeks caused by the strike of the steel workers.

6—The uncertain situation under which American companies operating in Mexico are laboring operates to minimize any chance of an overproduction of oil and the consequent breaking of the market. Due to the attitude of Carranza, the shipments of fuel crude from Mexico have been largely diminished, causing the unsettling of plans of many of the big oil companies and endangering their ability to fill contracts for fuel oil.

7—During 1919, according to the advance figures of the U. S. Geological Survey, production of crude in the United States reached a total of 377,000,000 barrels or a gain of more than 20,000,000 barrels over the production of the preceding year. It is recognized that 1919 was an exceptional year from a production standpoint and the vast increase over 1910 was due almost entirely to the high flush production of the north Texas and west Texas fields. Despite the great gain in oil brought out of the ground, however, stocks at the end of 1919 had been increased only 7,000,000 over the stocks on hand December 31, 1918.

A CORRECTION.

On Page 7 of the February issue of LUBRICATION, we stated that directions for finding absolute viscosity from the time of flow of the standard Saybolt viscosimeter were given in Technologic Paper number 100. The Bureau of Standards has kindly called our attention to the fact that this subject has been more completely investigated since Technologic Paper number 100 was issued, and more accurate results can be obtained by reference to Technologic Paper number 112.